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Viability, Government Support and the Service Function of Farmer Professional Cooperatives—Evidence from 487 Cooperatives in 13 Cities in Heilongjiang, China

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Abstract: As the main body that unites farmers internally and connects with markets externally, professional farmer cooperatives are playing an increasingly important role around the world. In order to investigate the significant factors influencing this subject in agricultural socialization services, 487 cooperatives in Heilongjiang Province were selected for investigation. The field survey found that many of the better-developed cooperatives have a certain degree of inadequacy in the performance of their service functions. This paper proposes that viability and government support are important factors influencing the realization of the service function of farmer professional cooperatives. Based on the empirical analysis of sample survey data and econometric models, it was demonstrated that the experience of the chairman, the number of board members, the distribution of members, the scale of land operation, profitability, and the institutional arrangement of the cooperatives are an important embodiment of the viability of the cooperatives. These factors significantly influence the service function of cooperatives in different sections, including pre-production, mid-production, and post-production. Moreover, obtaining external support from the government is necessary for cooperatives at their primary stage of development, especially regarding relevant training, which can facilitate the realization of the service functions of cooperatives in all aspects.

Keywords: farmer professional cooperative; viability; government support; service function



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1. Introduction

The agricultural socialization service is a key way to realize the modernization of Chinese agriculture and promote the organic connection between small farmers and modern agriculture [1]. The establishment of the family contracting system has enabled agricultural production to make its first leap forward. However, this kind of family management, characterized by decentralized and small-scale operations, is difficult to adapt to in a highly competitive big market. Due to the low market position of farmers, there are serious information barriers in the purchase of agricultural materials in the pre-production section and the sale of agricultural products in the post-production section, which may result in high costs and low income, making it difficult to acquire more income, and this phenomenon is especially clear in developing countries [2]. At the same time, in the mid-production section, due to its small scale, the scale and scope of the economy cannot be realized, resulting in low production efficiency. Therefore, it is necessary to innovate the agricultural management system to realize the scale of operation. Farmer professional cooperatives, as an important part of the main body of new agricultural management, play a very important socialized service function in the operation process, and its superiority is

mainly reflected in the fact that it can better solve some problems encountered by farmers before, during, and after production. Against the background of the urgent need to promote agricultural socialized services, how to give full play to the service functions of professional farmer cooperatives in different links of the industrial chain plays an important role in realizing the modernization of agriculture and rural areas.

Under China's existing rural land system, the contradiction between the fragmentation of arable land and scale management is prominent. In economic and social development, there is a certain degree of mismatch between the system and reality. The experience of the world's agricultural economic development shows that the process of agricultural modernization in developed countries in Europe and the United States has generally experienced a continuous reduction in the number of farmers, the continuous specialization and scaling up of agricultural production, and the intensification of competition in agricultural products [3,4]. In the process of agricultural modernization in the United States, relying only on less than 1% of the population engaged in agriculture [5] to become the world's major food producer, such development cannot be separated from the application of modern technology and government support. As a country that has modernized its agriculture, French agriculture successively underwent land ownership reform [6], industrialization development, and government support after World War II. Agricultural cooperatives have always played an important role in this development [7,8]. Cooperatives are established in accordance with the basic principle of "equal status of members, democratic management, serving members for the purpose of seeking the common interests of all members", which means that, compared to traditional firms, cooperatives pay more attention to the livelihoods of their members. In order to ensure the supply of food in the context of the decreasing number of farmers, cooperatives can pool small farmers' land resources, use mechanical equipment for large-scale operations, and improve resource utilization efficiency. At the same time, in the demand-oriented market, the operation of cooperatives has also changed [9], which can better cope with the problem of production and the supply and marketing of agricultural products.

The latest data show that by the end of 2022, the number of surviving farmer professional cooperatives in China reached 2,243,600, an increase of 14,400 or 0.65% from the end of 2021. However, the existence of a large number of "shell cooperatives", "dormant cooperatives", and "listed cooperatives" ("Shell societies" refer to cooperatives with no actual participation by farmer members; "dormant societies" refer to cooperatives with no substantial production or business activities; and "listed societies" refer to cooperatives that have ceased to operate due to poor management.) has led to widespread questioning of the service function of cooperatives [10]. Developing farmer cooperatives is an effective approach to promoting the process of rural marketization and is a crucial measure for advancing agricultural and rural modernization [11].

President Jinping Xi is highly concerned about the development of new agricultural business entities and agricultural socialized services. In the context of rural revitalization, national policies have also gradually guided farmer cooperatives to take service function enhancement actions as a starting point to strengthen the service-driven capacity of farmer cooperatives. In 2019, the Ministry of Agriculture and Rural Development (MARD) issued Several Opinions on Carrying Out Actions to Standardize and Enhance Farmer Cooperatives, which attempts to guide farmer cooperatives in terms of their policy to promote the transformation of cooperatives from quantitative growth to quality enhancement by, among other things, upgrading their service functions. In 2020, the MARD prepared the Plan for the High-Quality Development of New Agricultural Management Subjects and Service Subjects (2020–2022), proposing to promote the improvement of the service capacity and high-quality development of farmer cooperatives in terms of upgrading the level of standardization of farmer cooperatives, enhancing the service-driven capacity of farmer cooperatives, and strengthening the leadership of pilot demonstrations. In the report of the twentieth National Congress of the Communist Party of China, it was proposed that "new agricultural business entities should be given in-depth action to upgrade their operations,

and family farms should be supported to set up farmer cooperatives, and cooperatives should be run as enterprises according to the needs of their development, so as to drive small farmers to operate cooperatively and increase their incomes together. Implement actions to promote socialized agricultural services and vigorously develop socialized services such as substitute plowing and planting, substitute management and harvesting, and full hosting". This direction of development was also re-emphasized in the Central Document No. 1 of 2023. A host of cooperatives relies on their original production base to carry out hosting business and actively participate in the agricultural socialized service system, eventually achieving good results. As an important part of the new agricultural management main body, farmer professional cooperatives play a very important socialized service function in the operation process, which is reflected in the three aspects of pre-production, mid-production, and post-production. In the pre-production segment, cooperatives can promote standardized agricultural production through scale management; in the mid-production segment, cooperatives can enhance the utilization rate of agricultural resources through the application of new agricultural technologies; and in the post-production segment, cooperatives can improve the efficiency of agricultural production through joint marketing. This paper addresses how to better unleash the service functions of farmer professional cooperatives in different agricultural production and operation segments at both the internal and external levels.

In recent years, a great deal of fruitful academic research has been carried out on the issue of professional farmer cooperatives. In terms of spatial dimension, farmer professional cooperatives have progressed to different degrees in developed and developing countries, and most of them are limited to developing countries [12]. As a result, some scholars have studied the similarities and differences in cooperative development among different countries [13]. In the time dimension, more research has centered on the development of cooperatives. There is a rich body of research on financial operations [14] and institutional arrangements [15] within cooperatives. Studies in the literature explore the relationship between government support and cooperative development [16]. Among the many factors in the development of cooperatives, which can promote the provision of their service functions? Existing related studies include the model, effectiveness [17], and path [18,19] of the socialized services of farmer cooperatives. Through a field survey in Jiangsu Province, Ref. [20] concluded that the establishment of an operational mechanism and service model adapted to market demand is the key to the rapid development of production service cooperatives. Various types of service cooperatives have the institutional advantage of organizing and serving farmers and are of great significance to food security, the development of the rural economy, and the increase in farmers' incomes. Ref. [21] argued that farmer professional cooperatives, with the purpose of serving their members, are the most direct and effective agricultural service organizations for farmers. From the perspective of agricultural industrialization, they constructed an analytical framework for the degree of the service function realization of farmer professional cooperatives and analyzed its influencing factors. Ref. [22] suggested that viability and external support are important factors that influence the realization of the service function of farmer cooperatives. Ref. [23] argued that the high-quality development of cooperatives provides crucial support for the green development of agriculture. From the existing literature, experts, and scholars are more concerned with the socialization services of cooperatives [24,25]. However, academic research on the service function of cooperatives is mainly limited to the provision of agricultural production materials and product sales for members, and research on the factors influencing the service function of cooperatives has not been carried out according to the different aspects of the services provided by cooperatives. Meanwhile, most of the existing literature on the analysis of the service function of the economic organizations of farmer professional cooperatives is limited to case studies and non-random sampling surveys in local areas [26,27]. There is a lack of in-depth quantitative research on the development of the economic organizations of farmer professional cooperatives, their service function,

and their influencing factors. Most of the literature is confined to qualitative research. This paper enriches the relevant research to some extent.

The fundamental reason for the rapid development of farmer professional cooperatives is that they can provide pre-production, mid-production, and post-production services that most farmers actually need. In the linkage process between cooperatives and farmers, cooperatives produce not only physical products but various types of services adapted to farmers' production and marketing activities [20]. From a development point of view, professional farmer cooperative economic organizations have become one of the most important ways to help small farmers to connect with the big market. In summary, the possible marginal contributions of this paper are as follows: (a) In terms of research content, this paper analyzes the factors influencing the service function of cooperatives in terms of viability and government support, both internally and externally, and refines the service function to analyze what the most important influencing factors in different aspects of pre-production, mid-production, and post-production are, so as to make the research content more systematic. (b) In terms of the research scope, this paper selects Heilongjiang Province as the research sample area, the main reason being that this province, as a largely agricultural province in China, has seen the rapid development of farmer professional cooperatives in recent years, and it is representative to take the service function of farmer professional cooperatives in this province as the research object. (c) In terms of the research methodology, based on the research data, this paper used the multivariate Ordered Probit Model to quantitatively analyze the factors influencing the service function of farmer professional cooperatives, which cannot only enrich the empirical research in this field but also provide a reference basis for the decision making of relevant departments.

The paper is organized as follows: the next section is the Materials and Methods, the third section is the Results, the fourth section is the Discussion, and finally, the fifth section is the Conclusions and Suggestions.

2. Materials and Methods

2.1. Theoretical Analysis

Agricultural modernization has always been an important goal of agricultural development, and the scale of services based on agricultural socialized services is also considered an effective way to achieve agricultural modernization [28]. The essence of agricultural socialized services is the division of labor in the field of agricultural production [29]; "service" is a group of concepts corresponding to the "production" and the social division of labor to specialize in the production sector. A sector is usually the production process performed by the sector, and the forward and backward production processes conducted by other sectors are called services. In the market for the supply of socialized services, agricultural socialized services are treated as service commodities that farmers can select and purchase as consumers. Professional farmer cooperatives are able to achieve the drive of farmers through the form of business organizations. The purpose of farmers voluntarily joining together to form cooperatives is the hope that the cooperatives will provide them with the services they need, which are related to the provision of seedling supply and procurement of agricultural materials at the pre-production stage, the provision of technical, cultivation, harvesting and other production management services at the mid-production stage, and the provision of the product acquisition, processing, and marketing services at the post-production stage, which include non-market internalized services of the organization and the externalized services of the organization in a market-oriented manner [21]. A host of scholars categorize agricultural production services into pre-production, mid-production, and post-production links, which can specifically include the supply of agricultural materials, machinery services, technical services, information services, and processing and marketing services in five categories. The paper is further divided according to the main services provided by farmer professional cooperatives at this stage, and the services provided by cooperatives to farmers at the stage of primary agricultural production can be divided into material supply services and other services. The supply of agricultural materi-

als includes basic services such as the supply of agricultural materials (seeds, pesticides, and fertilizers) and agricultural machinery (land leveling, sowing, mechanized cultivation, etc.), while other services mainly include field management (weeding, fertilizer application, irrigation and drainage, etc.), technology promotion (improved crop varieties, scientific fertilizer application, and guidance on other production techniques, etc.), as well as the supply of information (information on preferential policies in agriculture, and information on food prices and the market for agricultural materials, etc.). In fact, these services are basically provided throughout the entire agricultural production process, but based on material firstness, this paper classifies the tangible services provided by cooperatives during the production phase as pre-production services and the intangible services during the production phase as mid-production services. After the production of primary agricultural products, there is the post-production stage, where the main services provided by cooperatives include product processing, warehousing, and marketing services.

The creation of cooperative economic organizations in China can be divided into two categories according to the different initiating forces: one is based on the spontaneous formation of farmers, and the other is based on the promotion of external government forces. According to materialist dialectics, the change and development of anything result from internal and external causes. This occurs both by its inherent internal causes and closely related to certain external conditions. Internal causes are the basis for the change and development of things, external causes are the conditions for the change and development of things, and external causes work through internal causes. The realization of the service function of cooperatives also depends on endogenous factors, and this internal determinant is responsible for viability. From relevant studies, it is clear that the viability of cooperatives is mainly closely related to the chairperson, the members, and the operation of the cooperatives. Ref. [30] attributed the factors influencing the service function of cooperatives to the potential gains from organizing, the way the organization is created, and the socio-economic conditions. Ref. [31] categorized the influencing factors of the degree of realization of cooperative service functions as product characteristics, member characteristics, business conditions, and the institutional environment. Ref. [32] emphasized analyzing the impact of the external environment and internal dynamics of cooperatives on their service functions and standardization. They believe that product characteristics, transaction costs, market environment, and government policies are the main influencing factors. At the same time, the scale of land operation is the application prerequisite for the realization of agricultural socialized services [33], which is based on the returns to scale as a theoretical basis: the change in yield that can be obtained for the various factors of production change in the same proportion. Mechanical elements in agricultural socialized services are non-detachable, and in order to achieve optimal efficiency, they must be matched with the scale of the land. Therefore, the manpower situation, operational conditions, and institutional arrangements of cooperatives have an influence on the service functions of cooperatives. In addition, the influence of external forces on the formation and development of cooperative economic organizations is, to some extent, an empirical issue since the intervention of external forces helps to compensate for the shortage of the supply of entrepreneurs in cooperative organizations. In the early stages of the development of cooperatives, the government has greater influence and is an important external factor that influences the performance of the service function of cooperatives. The objective of this paper is not to identify all the possible influencing factors but to add the important influence of cooperatives' viability and external support on the degree of the realization of their service functions.

2.2. Research Hypothesis

In summary, viability based on an incentive-compatible system is a determining factor in the realization of the service function of cooperatives, while external support from governments is an important external factor. Based on the above analysis, this paper proposes the following hypotheses to be tested:

H1: *The human capital situation, such as the chairman of the cooperative, board members, and the overall composition of members, has an important influence on the viability of cooperatives, which can influence the overall service function of the cooperatives.*

H2: *The operation of the cooperative has a different influence on the role of the cooperatives before, during, and after production.*

H2-1: *According to the law of diminishing returns to scale, the size of cooperative membership and the scale of land operation may have a two-way effect on pre-production services.*

H2-2: *The increased profitability of the cooperative promotes the backward extension of the agricultural industry chain, facilitating the realization of the cooperative's post-production service function.*

H2-3: *The higher the demonstration grade of a cooperative indicates that the cooperative is better developed and has stronger viability, which is conducive to the realization of its overall service function.*

H3: *With reasonable profit distribution and democratic management, the viability of cooperatives is stronger, which is conducive to the realization of service functions, while a relatively concentrated shareholding structure may have an impact on the performance of cooperative service functions.*

H4: *Cooperatives receive relevant government support through government financial support and relevant training, and it is easier to perform their service functions, while different levels of government support for the production aspects of cooperatives influence the realization of their service functions to varying degrees.*

2.3. Data, Variables, and Descriptive Statistics

2.3.1. Data Sources

As of 30 December 2021, 95,165 farmer professional cooperatives in Heilongjiang Province were registered with the Department of Market Supervision Bureau, of which 68,171, or 71.64%, were plantation cooperatives. In this paper, according to the distribution of farmer cooperatives in the cities of Heilongjiang Province, the group conducted random sampling in May–August 2022 according to the proportion of 8–10% of the locations of planting professional cooperatives in the cities of Heilongjiang Province. A total of 500 planting cooperatives were selected for the questionnaire survey, and the research sample covered 13 cities, including Harbin, Qiqihar, Suihua, Daqing, Jiamusi, and Mudanjiang. The survey respondents in this paper are all the presidents of farmer professional cooperatives, and the questionnaire survey on the operation and management of the cooperatives was conducted in the form of face-to-face interviews and online telephone research. In total, 13 invalid questionnaires were excluded, and finally, 487 valid questionnaires were obtained, with an overall questionnaire validity rate of 97.4%.

2.3.2. Description of Variables and Descriptive Statistics

The services provided by farmer professional cooperatives to farmers are divided into three segments according to the areas in which they are involved: pre-production services (PS), mid-production services (MS), and post-production services (PPS). In this paper, pre-production services are subdivided into agricultural capital services and agricultural machinery services; mid-production services are specifically subdivided into the care of the field, technology promotion, and information supply; and post-production services are divided into storage, processing, and sales. Therefore, there are three core explained variables in this paper, including the pre-production services, mid-production services, and post-production services provided by cooperatives. The value is assigned according to the types of services involved in different industrial chain links of farmer professional cooperatives. For example, for the cooperatives involved in the pre-production link that do

not provide services, the value is 0; to provide one kind of service, the value is assigned as 1; and to provide two kinds of services, the value is assigned as 2. The mid-production services are subdivided into three categories such that if the cooperative is involved in the mid-production chain and does not provide any service, it is assigned a value of 0; if it provides one service, it is assigned a value of 1; if it provides two services, it is assigned a value of 2; and if it provides three services, it is assigned a value of 3; Post-production service assignments are the same as for mid-production services. The overall services (OS) involve eight types, and the evaluation of specific service functions is shown in Table 1.

Table 1. Evaluation table of cooperative service functions.

Variables	Service Function Evaluation Dimensions	Definitions and Metrics	Mean	Standard Deviation
Pre-production services (PSs)	Agricultural services Agricultural machinery services	no service = 0; one service involved = 1; two services involved = 2.	0.721	0.770
Mid-production services (MSs)	Care of field Technology promotion Information supply	no service = 0; one service involved = 1; two services involved = 2; three services involved = 3.	0.906	1.067
Post-production services (PPSs)	Storage Processing Sales	no service = 0; one service involved = 1; two services involved = 2; three services involved = 3.	0.678	0.973
Overall services (OSs)	Agricultural services Agricultural machinery services Care of field Technology promotion Information supply Storage Processing Sales	no service = 0; one service involved = 1; two services involved = 2; three services involved = 3; four services involved = 4; five services involved = 5; six services involved = 6; seven services involved = 7; eight services involved = 8.	2.304	2.118

This paper sets up secondary indicators under the two primary indicators of viability and government support. Based on existing studies, three aspects, namely, individual characteristics, organizational characteristics, and institutional arrangements were selected as secondary indicators of internal drive in the provision of services by cooperatives; government financial support (FIN) and government provision of training (TRAIN) were selected as secondary indicators of government support. In terms of individual characteristics, this paper mainly focuses on the selection of variables from the two major aspects of the characteristics of the chairman and the characteristics of the members; the characteristics of the chairman include the experience of the chairman (EXP) and their household income (INCOME); the characteristics of the members include the number of board members (UBM), the number of members (UM), and the regional distribution of members (RDM). In terms of organizational characteristics, there are three specific indicators such as the demonstration grade of cooperatives (DEMO), the scale of land operation (SC), and the profitability of cooperatives (PC). In terms of institutional arrangements, the indicators were selected from four aspects, namely, the property rights structure (PRS), the decision making mechanism (DMM), profit distribution mechanism (PDM), and supervisory mechanism (PM), with the chairman of the board of directors' shareholding representing the structure of property rights; this included whether the members have a second dividend (DIV) and the type of cooperative's retained subsequent operating funds (FRS) representing the profit distribution mechanism alongside the number of supervisory board members and the voting method representing the governance mechanism (supervisory mechanism and decision making mechanism). Under government support, two secondary indicators

are government financial support (FIN) and government training (TRAIN). The specific variable categorization, setting, description, and descriptive statistics for each indicator are explained in detail in Table 2.

Table 2. Selection of cooperative service function indicators and descriptive statistics.

Categorization	Settings	Description	Mean	Standard Deviation	
individual characteristics	chairman	experience (EXP)	1 = 1 experience; 2 = 2; 3 = 3; 4 = 4 and above.	1.739	0.896
		household income (INCOME)	1 = USD 3,225,750 and below; 2 = USD 3,225,750 to USD 6,451,500; 3 = USD 6,451,500 to USD 9,677,250; 4 = USD 9,677,250 to USD 12,903,000; 5 = USD 12,903,000 and above.	8.439	4.806
	members	the number of board members (UBM)	0 = 0; 1 = 1; 2 = 2; 3 = 3; 4 = 4; 5 = 5 and above.	4.244	1.214
		the number of members (UM)	1 = 0–200; 2 = 200–500; 3 = 500–1000; 4 = 1000–2000; 5 = more than 2000.	1.345	0.799
		the regional distribution of members (RDM)	1 = home village; 2 = inter-village; 3 = inter-township; 4 = inter-county; 5 = inter-municipal.	1.444	0.884
		the demonstration grade (DEMO)	0 = not a model society; 1 = county model society; 2 = municipal model society; 3 = provincial model society; 4 = national model society. 1 = less than 1000 acres; 2 = 1000 acres–5000 acres; 3 = 5000–10,000 acres; 4 = 10,000–20,000 acres; 5 = more than 20,000 acres.	0.842	1.230
	the scale of land operation (SC)	0 = no profit or loss; 1 = 0–500,000; 2 = 500–1,000,000; 3 = 1–2,000,000; 4 = over 2,000,000.	2.187	1.149	
organizational characteristics		the profitability of cooperatives (PC)	1 = 20% and below; 2 = 20% to 40%; 3 = 40% to 60%; 4 = 60 to 80%; 5 = 80% and above.	1.337	1.143
			0 = No; 1 = Yes.	0.565	0.496
viability	property rights structure (PRS)	Chairman's share	0 = no retention; 1 = retention of provident fund or public welfare or risk fund;	2.478	1.467
		whether or not there is a secondary dividend for members of the society	2 = retention of two of provident fund, public welfare or risk fund; 3 = retention of provident fund, public welfare and risk fund.	0.495	0.672
	profit distribution mechanism (PDM)	What funds are retained by the cooperative for subsequent operations	0 = no retention; 1 = retention of provident fund or public welfare or risk fund;	0.495	0.672
		number of supervisory board members	2 = retention of two of provident fund, public welfare or risk fund; 3 = retention of provident fund, public welfare and risk fund.	2.729	1.383
	governance mechanism (GM)	method of voting	0 = 0; 1 = 1; 2 = 2; 3 = 3; 4 = 4; 5 = 5 and above. 1 = one person, one vote; 2 = one share, one vote; 3 = collective discussion of the decision of the chairperson of the board; 4 = deliberation of the core members; 5 = other.	2.470	1.303

Table 2. Cont.

Categorization	Settings	Description	Mean	Standard Deviation	
government support	government financial support (FIN)	data on whether the cooperative has received government support funds in the past two years Number of times local governments provided training in agricultural production for cooperative directors or cooperative members	0 = No; 1 = Yes. 0 = 0; 1 = 1 to 3 times; 2 = 4 to 6 times; 3 = 7 to 9 times; 4 = 10 to 12 times; 5 = more than 12 times.	0.230	0.421
	government provision of training (TRAIN)		0.914	0.837	

2.4. Model Selection and Covariance Test

2.4.1. Model Building

Based on the theoretical analysis, research hypotheses, and variable settings, the dependent variables in this study are all ordered discrete data. Using a probability model for regression analysis is the ideal approach. Therefore, this paper employs the Ordered Probit Model to analyze the influence of cooperative and government factors on pre-production, mid-production, post-production, and overall services provided by cooperatives. The specific model form is as follows:

The pre-production link service function is as follows:

$$y_1 = \alpha_0 + \sum_{i=1}^{15} \alpha_i x_i + \varepsilon_1, \quad (1)$$

$$y_1 = \begin{cases} 0 & \text{Neither agricultural purchasing nor agricultural machinery services} \\ 1 & \text{Agricultural purchasing or agricultural machinery services} \\ 2 & \text{Agricultural purchasing and agricultural machinery services} \end{cases} \quad (2)$$

where y_1 denotes the explained variable and $x_1 \sim x_{15}$ are the explanatory variables.

The mid-production link service function is as follows:

$$y_2 = \beta_0 + \sum_{i=1}^{15} \beta_i x_i + \varepsilon_2, \quad (3)$$

$$y_2 = \begin{cases} 0 & \text{No field management, technical extension and information supply services} \\ 1 & \text{Field management or technology extension or information supply services} \\ 2 & \text{Two of field management, technology extension and information supply services} \\ 3 & \text{Field management, technical extension and information supply services} \end{cases} \quad (4)$$

where y_2 denotes the explained variable and $x_1 \sim x_{15}$ are the explanatory variables.

The post-production link service function is as follows:

$$y_3 = \gamma_0 + \sum_{i=1}^{15} \gamma_i x_i + \varepsilon_3, \quad (5)$$

$$y_3 = \begin{cases} 0 & \text{No storage, processing and sales services} \\ 1 & \text{storage or processing or sales services} \\ 2 & \text{two of the storage, processing and sales services} \\ 3 & \text{storage, processing and sales services} \end{cases} \quad (6)$$

where y_3 denotes the explained variable and $x_1 \sim x_{15}$ are the explanatory variables.

2.4.2. Covariance Test

The variance inflation factor (VIF) is a metric that measures the severity of multicollinearity in a multiple linear regression model. The closer the VIF value is to 1, the lighter the multicollinearity, and vice versa. Usually, 10 is used as the judgment boundary. When $VIF < 10$, there is no multicollinearity; when $10 \leq VIF < 100$, there is strong multicollinearity; when $VIF \geq 100$, there is severe multicollinearity. In order to avoid the existence of multicollinearity among the independent variables, this paper utilized StataSE15.1 (StataCorp LLC, College Station, TX, USA) and conducted the covariance test for the 15 core explanatory variables before conducting the model analysis. The results showed that the VIF values of the variables ranged from 1.03 to 1.60. The average VIF value was 1.32, indicating no multicollinearity among the variables, and the model passed the covariance test.

3. Results

In this paper, StataSE15 (64-bit) was used to analyze the influence of cooperatives' self-reproductive capacity and government support on cooperatives' pre-production, in-production, and post-production services as well as the overall service functions, and the specific results of the analysis are shown below.

3.1. Benchmark Model Analysis Results

3.1.1. Influence on the Pre-Production Services Function of Cooperatives

In terms of the influence of individual characteristics on the pre-production service function of cooperatives, the president's experience in the field, the number of board members, and the number of members have significant influence. Among them, the overall influence of the director's experience on the pre-production service function of cooperatives is positive through the 1% significance level test; the influence of the number of members on the pre-production service function of cooperatives is negative through the 1% significance level test; and the influence of the number of board members on the pre-production service function of cooperatives is positive through the 10% significance level test. From the results of the marginal effect analysis and among the individual characteristics, the first result is that the number of members has the greatest influence on the pre-production service function of the cooperatives, but this influence is negative; that is, the increase in the number of members of the cooperatives will only not enhance the pre-production service function of the cooperatives, but also weakens the pre-production service function of the cooperatives, and the degree of weakening is deepened when the cooperatives increase the pre-production service. This shows that if cooperatives want to improve the function of pre-production services, it is not the case that more members are better, as when cooperatives do not provide pre-production services, the moderate increase in the number of members can promote the cooperative agricultural purchasing services and agricultural machinery services function, and when the cooperative provides pre-production services, it is based on the carrying capacity of the cooperative to determine a reasonable size of the members. The second result is that the experience of the chairperson in the profession has the second highest influence on the pre-production service function of the cooperatives. When farmer professional cooperatives do not provide services to their members, the director's experience in the field negatively impacts the functioning of the cooperative's pre-production services. This phenomenon may be due to the fact that the chairman of the board of directors, who has no sense of service and is more experienced in running a business, prefers at this point in time to obtain more operational benefits by running the business entirely on his own. However, when the cooperative provides only one kind of pre-production service for its members, the richer the experience of the director is, the more he or she drives the function of the cooperative's agricultural purchasing service or the function of the agricultural machinery service, and when the farmer professional cooperatives provide two kinds of pre-production services for its members, the degree of influence of the director's experience on the function of the cooperative's pre-production services is

further increased. The third result is that the influence of the number of board members on the pre-production service function of the cooperative is similar to the experience of the board chairman in the field, which also increases with the increase in the pre-production service function of the cooperative, but its significance is weaker than that of the experience in the field and the number of members.

In terms of the influence of organizational characteristics on the pre-production service function of cooperatives, the size of land operation significantly influences it. The overall influence of the pre-production service function of land management scale cooperatives is positive and passes the 1% significance level test. From the marginal effects analysis results, when cooperatives do not provide pre-production services, more cooperatives tend not to provide pre-production services to their members as the scale of cooperative land operations increases. However, when cooperatives provide one or two pre-production services to their members, the expansion of the scale of the cooperative's land operations facilitates the functioning of the cooperative's pre-production services. When cooperatives provide members with either agricultural purchasing services or agricultural machinery services, pre-production services increase by 2.48% for every one-level increase in the scale of land management. And when cooperatives provide both agricultural purchasing services and agricultural machinery services to their members, pre-production services increase by 5.87% for every one-level increase in the size of the land operation, which doubles this influence.

In terms of the influence of institutional arrangements on the pre-production service function of cooperatives, the ownership structure of cooperatives' profit distribution did not significantly influence the performance of the pre-production service function of cooperatives. However, the voting method in the governance mechanism significantly influences the pre-production service function of the cooperative, which is negative and passes the 1% significance level test. From the marginal effect analysis results, when cooperatives provide only one type of pre-production service for their members, the more centralized the decision-making power is, the more detrimental it is to the functioning of the cooperative's pre-production service. This negative influence is also further deepened when the cooperative provides two pre-production services to its members, increasing the level of impact by more than one factor. The more the voting method of farmer professional cooperatives tends to be "one person, one vote", the more conducive it is to the performance of their pre-production service function.

In terms of the influence of government support on the functioning of pre-production services of cooperatives, the financial support of the government did not have a significant influence on the performance of pre-production services of cooperatives, while the influence of government training on the pre-production services of cooperatives was extremely significant, and the results passed the test of the 1% significance level. This influence likewise deepens as the type of pre-production services provided by cooperatives increases, and the level of influence also increases more than onefold, which may be related to the higher level of productive training provided by the government. The specific regression results are shown in Table 3.

Table 3. Analysis of empirical results influencing pre-production services of cooperatives.

Variables	Coefficient		Marginal Effect	
	PS	PS = 0	PS = 1	PS = 2
EXP	0.268 *** (4.44)	-0.0850 *** (-4.55)	0.0253 *** (3.75)	0.0598 *** (4.55)
INCOME	-0.0680 (-0.76)	0.0216 (0.76)	-0.00642 (-0.75)	-0.0152 (-0.76)
UBM	0.0914 * (1.85)	-0.0290 * (-1.87)	0.00863 * (1.89)	0.0204 * (1.83)

Table 3. Cont.

Variables	Coefficient		Marginal Effect	
	PS	PS = 0	PS = 1	PS = 2
UM	−0.490 *** (−5.31)	0.155 *** (5.61)	−0.0462 *** (−4.95)	−0.109 *** (−5.17)
RDM	0.0735 (1.07)	−0.0233 (−1.07)	0.00694 (1.06)	0.0164 (1.07)
DEMO	0.0808 (1.49)	−0.0257 (−1.49)	0.00763 (1.47)	0.0180 (1.49)
SC	0.263 *** (4.36)	−0.0853 *** (−4.51)	0.0248 *** (3.89)	0.0587 *** (4.41)
PC	0.0817 (1.34)	−0.0259 (−1.35)	0.00771 (1.35)	0.0182 (1.34)
PRS	0.0498 (1.21)	−0.0158 (−1.21)	0.00470 (1.18)	0.0111 (1.21)
DIV	0.195 (1.39)	−0.0618 (−1.40)	0.0184 (1.40)	0.0435 (1.38)
FRS	0.0816 (0.91)	−0.0259 (−0.91)	0.00770 (0.91)	0.0182 (0.91)
PM	0.0614 (1.34)	−0.0195 (−1.34)	0.00580 (1.32)	0.0137 (1.34)
DMM	−0.121 *** (−2.86)	0.0387 *** (2.92)	−0.0115 *** (−2.72)	−0.0272 *** (−2.89)
FIN	−0.0434 (−0.29)	0.0138 (0.29)	−0.00410 (−0.29)	−0.00969 (−0.29)
TRAIN	0.238 *** (3.00)	−0.0755 *** (−3.06)	0.0224 *** (2.80)	0.0531 *** (3.05)
R ²	0.155			
N			487	

t statistics in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

3.1.2. Influence on the Mid-Production Services Function of Cooperatives

The influence of cooperatives' viability and government support on cooperatives' mid-production service provision are specified in Table 4.

Table 4. Analysis of empirical results influencing mid-production services of cooperatives.

Variables	Coefficient		Marginal Effect	
	MS	MS = 1	MS = 2	MS = 3
EXP	0.0955 (1.53)	0.00474 (1.52)	0.0111 (1.54)	0.0161 (1.50)
INCOME	−0.172 ** (−2.06)	−0.00857 * (−1.91)	−0.0201 ** (−2.05)	−0.0290 ** (−2.03)
UBM	0.124 ** (2.51)	0.00617 ** (2.33)	0.0145 ** (2.43)	0.0209 ** (2.51)
UM	−0.0750 (−0.87)	−0.00373 (−0.85)	−0.00875 (−0.87)	−0.0126 (−0.86)
RDM	0.159 ** (2.47)	0.00790 ** (2.25)	0.0185 ** (2.42)	0.0267 ** (2.49)
DEMO	0.0454 (0.89)	0.00226 (0.87)	0.00529 (0.88)	0.00764 (0.89)
SC	0.0261 (0.45)	0.00130 (0.45)	0.00304 (0.45)	0.00439 (0.45)
PC	0.0385 (0.68)	0.00192 (0.68)	0.00449 (0.68)	0.00648 (0.68)
PRS	0.00132 (0.03)	0.0000657 (0.03)	0.000154 (0.03)	0.000222 (0.03)

Table 4. Cont.

Variables	Coefficient		Marginal Effect	
	MS	MS = 1	MS = 2	MS = 3
DIV	0.609 *** (4.51)	0.0303 *** (4.06)	0.0711 *** (4.53)	0.103 *** (4.15)
FRS	0.179 ** (1.98)	0.00891 * (1.86)	0.0209 * (1.96)	0.0301 * (1.97)
PM	-0.0818 ** (-2.00)	-0.00407 * (-1.89)	-0.00955 ** (-1.98)	-0.0138 ** (-1.98)
DMM	-0.0177 (-0.43)	-0.000883 (-0.44)	-0.00207 (-0.43)	-0.00299 (-0.43)
FIN	0.289 ** (2.16)	0.0144 ** (1.99)	0.0337 ** (2.14)	0.0487 ** (2.17)
TRAIN	0.204 *** (2.81)	0.0101 ** (2.58)	0.0238 *** (2.78)	0.0343 *** (2.75)
R ²	0.106			
N			487	

t statistics in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

In terms of the influence of individual characteristics on the cooperative's mid-production service function, the household income, the number of board members, and the regional distribution of members have significant influence on the cooperative's mid-production service function, and all three explanatory variables passed the 5% significance level test. First, household income has a negative impact on the cooperative's mid-production services, which suggests that the higher the household income of the chairperson, the more it constrains the functioning of the cooperative's mid-production services. And the results of the analysis of marginal effects show that as the type of mid-production services provided by the cooperative increases, the increase in the household income of the director further constrains the functioning of the cooperative's mid-production services. Secondly, the influence of the number of board members on the cooperative's mid-production services is positive; the stronger the cooperative's mid-production service capacity, the more it contributes to the functioning of the cooperative's mid-production services as the number of cooperative board members increases. Third, the wider the regional distribution of members, the more cooperatives tend to be associated with the provision of mid-production services.

In terms of the influence of institutional arrangements on the cooperative's mid-production service function, whether or not there is a secondary dividend for members, the cooperative's retention of provident funds, public welfare funds, and risk funds, and the number of supervisory board members all have a significant influence on the cooperative's mid-production service function. First of all, the availability of secondary dividends for members has a positive effect on the performance of the cooperative's mid-production services, and this variable is extremely significant, passing the 1% significance level test. When cooperatives make arrangements for the distribution of profits with secondary dividends to their members, it promotes the further development of the cooperative's mid-production service function. Secondly, the cooperative's retained capital status also positively influences mid-production services, passing the 10% significance level test. This indicates that the retention of the provident fund, the public welfare fund, and the risk fund is beneficial to cooperatives in providing mid-production services to members, and when the types of subsequent operating funds retained by cooperatives increase, the mid-production service function of cooperatives can be improved. Finally, the influence of the number of members of the supervisory board on the increase in the type of services in the cooperative's output is negative and passes the 5% significance level test, and the increase in the number of members of the supervisory board does not contribute to the increase in the type of service functions in the cooperative's output.

In terms of the influence of government support on the functioning of cooperatives' mid-production services, both government financial support and government training have a significant positive influence on the increase in the types of cooperatives' mid-production services, with government financial support passing the test of significance at the 5% level and government training passing the test of significance at the 1% level. From the comparative analysis of these two variables, it is clear that the indicator of government financial support has a greater influence on the performance of the cooperative's mid-production service function than government training. When cooperatives provide two types of mid-production services, the provision of financial support by the government promotes a 3.37% increase in the level of mid-production services provided by cooperatives. And when cooperatives provide three types of mid-production services, the government's provision of financial support promotes a 4.87% increase in the level of mid-production services of cooperatives, which may be related to the fact that the government's financial investment in cooperatives is mostly utilized in the mid-production process.

3.1.3. Influence on the Post-Production Services Function of Cooperatives

The explanatory variables influencing the post-production services of the cooperatives have increased compared to the explanatory variables influencing the cooperatives' pre-production services and mid-production services, which have significance, as explained in detail in Table 5.

Table 5. Analysis of empirical results influencing post-production services of cooperatives.

Variables	Coefficient		Marginal Effect	
	PPS	PPS = 1	PPS = 2	PPS = 3
EXP	0.114 *	0.00631 *	0.0161 *	0.0122 *
	(1.77)	(1.73)	(1.80)	(1.69)
INCOME	-0.0398	-0.00221	-0.00562	-0.00428
	(-0.51)	(-0.51)	(-0.51)	(-0.51)
UBM	0.166 ***	0.00923 ***	0.0235 ***	0.0179 ***
	(2.94)	(2.75)	(2.82)	(2.87)
UM	-0.226 **	-0.0125 **	-0.0319 **	-0.0243 **
	(-2.15)	(-2.07)	(-2.12)	(-2.05)
RDM	0.113 *	0.00628	0.0160 *	0.0122
	(1.66)	(1.64)	(1.67)	(1.63)
DEMO	0.0642	0.00356	0.00907	0.00690
	(1.22)	(1.20)	(1.22)	(1.21)
SC	-0.0177	-0.000981	-0.00250	-0.00190
	(-0.28)	(-0.28)	(-0.28)	(-0.28)
PC	0.149 ***	0.00828 **	0.0211 ***	0.0160 ***
	(2.74)	(2.52)	(2.68)	(2.68)
PRS	0.0508	0.00282	0.00718	0.00547
	(1.15)	(1.14)	(1.14)	(1.15)
DIV	0.517 ***	0.0287 ***	0.0731 ***	0.0556 ***
	(3.47)	(3.55)	(3.39)	(3.12)
FRS	0.245 ***	0.0136 **	0.0347 ***	0.0264 **
	(2.65)	(2.39)	(2.64)	(2.55)
PM	-0.0867 *	-0.00482 *	-0.0123 *	-0.00933 *
	(-1.92)	(-1.83)	(-1.87)	(-1.94)
DMM	-0.0298	-0.00165	-0.00421	-0.00320
	(-0.66)	(-0.66)	(-0.66)	(-0.65)
FIN	0.0905	0.00503	0.0128	0.00973
	(0.58)	(0.58)	(0.58)	(0.58)
TRAIN	0.146 *	0.00813 *	0.0207 *	0.0158 *
	(1.85)	(1.81)	(1.84)	(1.84)
R ²	0.130			
N			487	

t statistics in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

In terms of the influence of individual characteristics on the functioning of cooperatives' post-production services, the chairperson's experience, the number of board members, and the number of members significantly influence the post-production services of cooperatives. In this case, the number of board members passed the 1% significance level test, the number of community members passed the 5% significance level test, and the president's experience in the field passed the 10% significance level test. The greater experience of the chairperson and the increase in the number of board members positively influence the development of post-production services in cooperatives. However, it is worth noting that the influence of these two variables is greatest when the cooperative provides two of the storage, processing, and marketing services and decreases when the cooperative provides all three post-production services. In addition, the number of members continues to have a negative influence on the increase in the type of post-production services of cooperatives, and the influence of this variable on the post-production services of cooperatives is in the same type as that of the pre-production services, which means that an increase in the number of members of cooperatives weakens the post-production service function of cooperatives. A moderate increase in the number of members can promote an increase in the types of post-production services provided by cooperatives, but when cooperatives provide post-production services, they should determine a reasonable size of membership based on the carrying capacity of the cooperative, which further validates the importance of the size of membership.

In terms of the influence of organizational characteristics on the functioning of post-production services of cooperatives, the profitability of cooperatives is the new significant influence variable; this variable is not significant in the measurement of the influence of pre-production services and the in-production services of cooperatives but significantly influences the development of post-production services of cooperatives, and the variable passes the test of significance at the level of 1%, and the direction of the influence is positive. This reflects the fact that the increased profitability of cooperatives promotes the provision of more post-production services by cooperatives. This is directly related to the reality that many cooperatives move towards extending the industrial chain after the increase in profitability and carrying out the phenomenon of agricultural storage, processing, and sales, and the significance of this variable validates the reality.

In terms of the influence of institutional arrangements on the functioning of the post-production services of cooperatives, the availability of secondary dividends for members, the situation of the retained funds of cooperatives, and the number of members of supervisory boards all have a significant influence on the increase in the types of post-production services of cooperatives. Among them, the influence of whether members have secondary dividends and the situation of the retained funds of cooperatives on the function of the post-production services of cooperatives is positive, which passes the 1% and 5% significance level tests, respectively. The influence of the number of members of the supervisory board on the increase in the type of post-production services of the cooperative is negative; that is, the increase in the number of members of the supervisory board is not conducive to the increase in the type of post-production service functions of the cooperative, similar to its influence on the mid-production services, and this variable passes the test of the 10% level of significance. The results of the marginal effects analysis show that the influence of all these significant variables on the post-production services of the cooperative is greatest when the cooperative provides two types of storage: processing and sales services.

In terms of the influence of government support on the functioning of post-production services of cooperatives, the variable of government training continues to play a significant and positive role in this aspect, and government training passes the test of significance at the level of 10%. From the results of the marginal effect, when cooperatives provide two types of post-production services, the post-production service function of cooperatives improves by 0.0207 units for every unit of improvement in government training, that is, for every increase in government training by about three times. When cooperatives provide

three post-production services, the cooperative's post-production service function improves by 0.0158 units for every unit improvement in government training.

3.1.4. Influence on the Overall Services Function of Cooperatives

Table 6 shows the results affecting the overall service function of the cooperative. In terms of the influence of individual characteristics on the overall service function of the cooperatives, the president's experience in the field, the number of board members, the number of members, and the regional distribution of members all have significant influence. In this case, the overall influence of the experience of the chairman and the number of members of the board of directors on the overall service function of the cooperative was positive and passed the 1% significance level test. The influence of the number of members on the overall service function of the cooperative was negative, and the influence of the regional distribution of members on the overall service function of the cooperative was positive, and both variables passed the 10% significance level test. The results of the marginal effect analysis show that among the individual characteristics, and the number of members has the greatest negative influence on the overall service function of the cooperative. On the other hand, the experience of the chairperson, the number of board members, and the regional distribution of members strongly positively influence the cooperative's overall service function.

Table 6. Analysis of empirical results influencing the overall services of cooperatives.

Variables	Coefficient		Marginal Effect	
	OS	OS = 6	OS = 7	OS = 8
EXP	0.197 *** (3.44)	0.0121 *** (3.01)	0.00687 ** (2.55)	0.00780 *** (2.60)
INCOME	-0.130 (-1.54)	-0.00797 (-1.49)	-0.00453 (-1.41)	-0.00515 (-1.48)
UBM	0.181 *** (3.97)	0.0111 *** (3.33)	0.00633 *** (2.81)	0.00719 *** (2.74)
UM	-0.298 *** (-3.58)	-0.0183 *** (-3.00)	-0.0104 *** (-2.73)	-0.0118 ** (-2.51)
RDM	0.145 ** (2.33)	0.00887 ** (2.28)	0.00505 * (1.85)	0.00573 ** (2.16)
DEMO	0.0764 (1.58)	0.00468 (1.50)	0.00267 (1.42)	0.00303 (1.58)
SC	0.110 ** (2.11)	0.00676 * (1.95)	0.00385 * (1.87)	0.00437 * (1.87)
PC	0.113 ** (2.03)	0.00691 * (1.93)	0.00393 * (1.83)	0.00446 * (1.83)
PRS	0.0494 (1.32)	0.00303 (1.30)	0.00172 (1.22)	0.00196 (1.28)
DIV	0.602 *** (4.84)	0.0369 *** (3.8)	0.0210 *** (2.86)	0.0239 *** (2.98)
FRS	0.222 *** (2.94)	0.0136 *** (2.73)	0.00777 ** (2.26)	0.00881 ** (2.30)
PM	-0.0561 (-1.48)	-0.00344 (-1.41)	-0.00196 (-1.43)	-0.00222 (-1.45)
DMM	-0.0894 ** (-2.36)	-0.00548 ** (-2.22)	-0.00312 ** (-2.06)	-0.00354 ** (-1.99)
FIN	0.168 (1.28)	0.0103 (1.24)	0.00587 (1.24)	0.00667 (1.20)
TRAIN	0.280 *** (3.73)	0.0172 *** (3.37)	0.00978 *** (3.00)	0.0111 ** (2.54)
R ²	0.133			
N			487	

t statistics in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

In terms of the influence of organizational characteristics on the overall service function of cooperatives, land operation scale and cooperative profitability positively influenced it, passing the 10% significance level test. From the results of the marginal effect analysis, it is clear that the larger the size of the cooperative's land dealings and the more profitable the cooperative's operations, the more it contributes to the overall service function of the cooperative.

In terms of the influence of institutional arrangements on the overall service function of the cooperatives, the way in which the profits of cooperatives are distributed and the way in which they are voted have significant influence. The influence of whether members have secondary dividends was positive, tested at the 1% significance level; the influence of the cooperative's retained funds status was positive, tested at the 5% significance level; and the influence of voting method was negative, tested at the 5% significance level. From the results of the marginal effect analysis, the more reasonable the profit distribution and the fairer the decision-making of the cooperatives, the more conducive it is to the overall service function of the cooperatives.

In terms of government support's influence on cooperatives' overall service function, government training has a significant and positive influence. This suggests that the more training provided by the government, the more it facilitates the overall service function of the cooperatives.

3.2. Robustness Analyses

In order to verify the accuracy of the previous findings, a robustness test was necessary. The following discussion of robustness focuses on changing the measurement model and the way the explanatory variables are measured.

3.2.1. Multivariate Ordered Logistic Model

The previous econometric test was conducted using a multivariate Ordered Probit Model; this paper has more categorical variables in the explanatory variables, so a re-test was considered using the multivariate Ordered Logistic Model. In the case of post-production services, the coefficient on the experience of the cooperative's director was positive but not significant, indicating that its influence on the cooperative's post-production service profile is limited. As a whole, the household income of the chairman and the number of supervisory board members both passed the significance level test but still had a negative influence, indicating that if we want to improve the overall level of the cooperative's service function, we need to limit the increase in both to a certain extent. The coefficients and significance levels of the remaining explanatory variables are consistent with the original benchmark regression model results, and the marginal effects are very close. Overall, the regression results obtained with the multivariate Ordered Logistic Model are broadly consistent with the original benchmark regression model, indicating that the previous estimation results are robust and reliable.

3.2.2. Changing the Measure of Explanatory Variables

The previously mentioned land operation scale variable was tested by changing it from a categorical variable to a numerical variable, which is the total area of the cooperative's land operation in small acres. In pre-production services, the profitability of the cooperative changed from positively insignificant to positively significant, indicating that the more profitable the cooperative is, the higher the level of pre-production services in the cooperative. Although the mechanism of this variable's influence on the level of pre-production services is debatable, it can be taken into account when considering the improvement of the level of pre-production services. In post-production services, the regional distribution of cooperative members changed from positively significant to non-significant, indicating this explanatory variable's limited role in influencing post-production services. Overall, the demonstration rank of cooperatives changed from positively insignificant to positively significant, indicating that the higher the demonstration rank of cooperatives, the more it

can promote the overall service function of cooperatives. The coefficients and significance levels of the remaining explanatory variables are consistent with the original benchmark regression model results, and the marginal effects are very close. In sum, changing the measure of the landholding scale did not significantly alter the conclusions obtained from the original benchmark regression, again indicating that the previous estimation results are robust and reliable.

4. Discussion

This paper empirically analyzes the influence of cooperatives' viability and government support on their pre-production, mid-production, and post-production services through the survey data of a sample of 487 cooperatives in Heilongjiang Province. The results show that at the time of the formation of the cooperative, the chairman of the board of directors, who had more experience in the field and a relatively insignificant financial advantage, was selected, and the number of members of the cooperative's board of directors was appropriately increased, and a reasonable number of members on the supervisory board was established. On the other hand, the blind absorption of members and expansion of production are not conducive to the subsequent development of cooperatives. At the same time, the more rational the cooperative's profit distribution method and the more democratic its decision making and management methods, the more it can significantly enhance the cooperative's viability and promote the realization of the cooperatives' service function. In addition, obtaining external support from the government is essential for cooperatives that are currently in the early stages of development, and government support, especially the relevant training provided by the government, can facilitate the realization of the service functions of cooperatives. It is worth noting that the demonstration grade of farmer professional cooperatives does not have a significant influence on the performance of the cooperatives' service function, which is a side reflection of the fact that the existing evaluation index of the demonstration grade of cooperatives lacks a measure of the full performance of their service function.

This paper has some limitations. It only analyzes the internal and external influencing factors of the cooperative's productive economic service functions from the perspective of the industry chain. However, cooperatives are special organizations with economic and social attributes, characterized by pursuing economic development, social equality, and progress without profit as the goal. These determine that cooperatives should not only focus on the economic interests of their members but also care about the development of the community, especially in reducing poverty, creating fully efficient employment opportunities, and promoting fair and politically acceptable social development, the potential and role of which are irreplaceable. Therefore, in future research, the connotation of the service function of cooperatives can be further extended. At the same time, in terms of the research area, China has a vast territory, complex terrain, and diverse resources, and there are differences in the development and functions of cooperatives in different regions. This paper selects 487 farmer professional cooperatives in Heilongjiang Province, and further expansion of the regional coverage scope is needed.

5. Conclusions and Suggestions

5.1. Conclusions

The results of the analysis of the influence of the cooperatives' viability and government support on the cooperatives' pre-production, mid-production, post-production, and overall services lead to the following conclusions:

Membership characteristics of cooperatives. The richer the experience of the cooperative's director, the more he or she can promote the performance of the cooperative's pre-production, post-production, and overall services, but the greater his or her family's income inhibits the performance of the cooperative's mid-production services, such as field management, technology promotion, and information supply. The increase in the number of cooperative board members positively influences the overall service function of coop-

eratives, but it is not the case that the more members, the better; too many members can, to a certain extent, inhibit the cooperative's pre-production and post-production service function. At the same time, a wider regional distribution of members enhances the viability of cooperatives, and the wider the regional distribution of members, the more cooperatives are encouraged to provide more mid-production and overall services. Hypothesis 1 is fully tested.

Organizational characteristics of cooperatives. The scale of land operation significantly influences the pre-production and overall services, and the direction of the pre-production function influence is bi-directional; thus, Hypothesis 2-1 is verified. The more profitable cooperatives are, the more post-production services they provide, such as storage, processing, and sales to their members. Hypothesis 2-2 is verified. However, the demonstration grade of farmer professional cooperatives does not significantly influence the performance of the service function of the cooperatives. Finally, hypotheses 2-3 are not valid, which indicates that the evaluation index of the demonstration grade of the cooperatives does not include the evaluation of their service function. Hypothesis 2 was partially tested.

Institutional arrangements of cooperatives. The concentration of shareholding does not have a significant influence on the performance of the cooperative's service function, but the cooperative's reasonable profit distribution methods of distributing dividends twice for members and retaining a variety of follow-up operating funds have a significant positive influence on the cooperative's mid-production, post-production, and overall service functions. At the same time, the more democratic the management style is and the more reasonable the number of supervisory boards set, the better the service function of the cooperative provided. Hypothesis 3 is fully tested.

External support from the government. Government support enables cooperatives to have more viability, thus facilitating the further development of their service functions. Hypothesis 4 is well-tested. In particular, the training provided by the government has a significant contribution to the pre-production, mid-production, post-production, and overall service functions of cooperatives, and the influence of such training is more significant than that of direct financial support from the government.

5.2. Suggestions

The above findings suggest that viability and government support influence cooperative service functioning differently. The findings of this paper have the following policy implications:

First of all, cooperatives, when forming and with conditions permitting, should try to choose members with richer experience in the field and relatively less clear financial advantages to become chairman of the board of directors.

Secondly, in the development process of cooperatives, the land operation scale and membership scale have a significant influence on cooperatives, and determining a reasonable land operation scale and membership scale and appropriately absorbing farmers in different regions as members, when possible, can significantly enhance the realization of the service functions of cooperatives in different production segments.

Also, rational institutional arrangements are a source of viability for cooperatives. Relevant policies and regulations should promote the efficiency of cooperatives while at the same time taking fair care of the differentiated demands of members so as to help cooperatives provide viable services for all members. Cooperatives are composed of heterogeneous members, and different types of members have different behavioral objectives in cooperatives. Only an incentive-compatible system that satisfies these differentiated demands and maximizes collective interests can enable members to act coherently, thus allowing cooperatives to become self-sustaining and function appropriately as service providers.

Furthermore, an increase in government support, especially government training, can facilitate the realization of the service functions of cooperatives. At the same time, differentiated support policies should be formulated to enhance the role of government financial support. The agricultural socialization service's main body can be guided to carry out sci-

entific research and talent cooperation with scientific research institutes through rewarding instead of subsidizing to improve its technical level and professional service capacity [1].

Finally, the indicators for rating cooperatives should be improved, and the service function of cooperatives to their members should be taken more as an evaluation indicator. The scientific formulation of a system of evaluation indicators based on the current situation of cooperative development is to better enhance the viability of cooperatives, which is the key to cooperative development. Therefore, government support should be aimed at promoting the development of the viability of cooperatives, improving the external environment and conditions of cooperatives, and facilitating the realization of the service functions of cooperatives, with the modalities and content of support being gradually adjusted in the future in accordance with the reality of agricultural and rural development.

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References

- Guo, X.M.; Wen, G.Q. Development Logic, Realistic Obstacles and Optimization Path of Agricultural Socialized Services. *China Rural Econ.* **2023**, *7*, 21–35. [[CrossRef](#)]
- Neves MC, R.; Silva, F.F.; Freitas, C.O.; Braga, M.J. The role of cooperatives in Brazilian agricultural production. *Agriculture* **2021**, *11*, 948. [[CrossRef](#)]
- Mao, S.P.; Zhang, S.; Zhang, J. Experience and Reference of Agricultural Cooperative Development in the United States, European Union, and Japan. *J. Econ. Issues Res.* **2024**, *1*, 115–129.
- Wang, Z.J. Perspectives on the new generation of cooperatives in the United States. *China Rural Econ.* **2003**, *11*, 72–78.
- Chen, X. The experience and inspiration of the development of agricultural modernization in the United States. *Econ. Syst. Reform* **2019**, *6*, 157–162.
- Yang, H.; Lu, Z.Z. Marketization and Urban-Rural Equivalence: French Agricultural and Rural Modernization and Its Implications for China's Rural Revitalization. *Zhejiang J.* **2022**, *5*, 100–110. [[CrossRef](#)]
- Chaddad, F.R.; Cook, M.L. Understanding new cooperative models: An ownership control rights typology. *Appl. Econ. Perspect. Policy* **2004**, *26*, 348. [[CrossRef](#)]
- Xu, X.C.; Jia, G.D.; Liu, J.H. Development of agricultural cooperatives in Germany and some implications for China. *Rural Bus. Manag.* **2008**, *5*, 38–42.
- Qorri, D.; Felföldi, J. Research Trends in Agricultural Marketing Cooperatives: A Bibliometric Review. *Agriculture* **2024**, *14*, 199. [[CrossRef](#)]
- Ma, Y.L.; Li, Z.Z.; Jia, Y.C. Response to the Three Major Controversial Issues Regarding the Development Quality of Farmer Professional Cooperatives in China: An Evaluation Based on the “Zhejiang University Carter-Enterprise Research China Rural Study Database”. *China Rural Econ.* **2024**, *2*, 90–111.
- Zhao, X.F.; Chu, Q.Y. Service Rights and the Comprehensive Development of Farmer Cooperatives. *Guizhou Soc. Sci.* **2024**, *1*, 62–72.
- Rolfe, J.; Akbar, D.; Rahman, A.; Rajapaksa, D. Can cooperative business models solve horizontal and vertical coordination challenges? A case study in the Australian pineapple industry. *J. Co-Oper. Organ. Manag.* **2022**, *10*, 100184. [[CrossRef](#)]
- Li, Y.H.; Liu, H. How to Organically Connect Smallholder Farmers and Modern Agriculture in China—Insights Based on Japan and South Korea. *World Agric.* **2023**, *6*, 60–66. [[CrossRef](#)]
- Piccoli, P.; Bianchini, N., Jr.; Coser, J. Short-term financial sustainability of agricultural cooperatives. *Agric. Financ. Rev.* **2021**, *81*, 444–457. [[CrossRef](#)]

15. Ferreira da Silva, F.; Knebel Baggio, D.; Ferreira Lopes Santos, D. Governance and performance model for agricultural cooperatives. *Estud. Gerenciales* **2022**, *38*, 464–478. [[CrossRef](#)]
16. Cui, B.Y.; Ma, K.W.; Liu, Y. Can government support enhance the performance of farmers' cooperatives?—Evidence from 395 national model societies in Anhui Province. *Rural Econ.* **2023**, *7*, 113–122.
17. Liu, X. Socialized Services of Farmer Cooperatives: Models, Effects, and Implications. *J. Beijing Agric. Vocat. Coll.* **2021**, *35*, 37–43. [[CrossRef](#)]
18. Yuan, S.Y. The realization path of the service function of farmers' professional cooperatives—Based on the empirical revelation of Japanese agricultural cooperatives. *China Ind. Econ.* **2022**, *18*, 67–69.
19. Liu, X. Research on the Path of Enhancing the Socialized Service Function of Farmer Cooperatives under the Rural Revitalization Strategy. *South Agric.* **2021**, *15*, 112–114.
20. Sun, Y.F.; Wang, K. Analysis of the development and operation mechanism of farmers' production service cooperatives—A survey based on Jiangsu Province. *Agric. Econ. Issues* **2010**, *31*, 28–33+110–111. [[CrossRef](#)]
21. Huang, Z.H.; Gao, Y.L. The degree of realization of the service function of farmers' professional cooperatives and its influencing factors. *China Rural Econ.* **2012**, *7*, 4–16.
22. Wang, T.Z. Autopoietic capacity, external support, and service function of farmers' cooperatives. *Agric. Econ. Issues* **2017**, *38*, 14–27+110. [[CrossRef](#)]
23. Gao, J.; Zhou, J. Mechanism and Effectiveness of Cooperative High-Quality Development Promoting Improvement of Agricultural Green Productivity. *China Agric. Resour. Reg.* **2024**, *4*, 1–12.
24. Zhang, C.; Huang, B.; Zhong, Z. Mechanisms determining the radius of agricultural socialized services: Evidence from four farmers' cooperatives. *Reform* **2020**, *12*, 121–131.
25. Lu, Q.Z.; Zhang, Y.F. Income-generating effects of cooperative members' diversified socialized services: A counterfactual estimation based on the research data of farmers in Shandong Province. *J. Northwest Agric. For. Univ. (Soc. Sci. Ed.)* **2022**, *22*, 129–140. [[CrossRef](#)]
26. Huang, Z.H.; Liang, Q. Collective action of small farmers participating in the big market—An analysis on the example of Ruo Heng watermelon cooperative in Zhejiang Province. *Agric. Econ. Issues* **2007**, *9*, 66–71.
27. Kong, X.Z.; Guo, Y.Q. The basic situation, organization and management of farmers' cooperative economic organizations and the role of government at the present stage—A survey report on farmers' cooperative economic organizations in 23 provinces. *Agric. Econ. Issues* **2006**, *1*, 54–59.
28. Zhou, J.; Wan, L. The emergence, operation and significance of agricultural service cooperatives under the dual scale path of agricultural modernization. *Agric. Econ. Issues* **2023**, *7*, 76–87.
29. Mu, N.N.; Zhong, Z.; Kong, X.Z. Transaction cost and the choice of agricultural socialized service model-A comparative study based on two cooperatives. *J. Agric. For. Econ. Manag.* **2019**, *18*, 366–375.
30. Huang, J.K.; Deng, H.S.; Xu, Z.G. The service function of Chinese farmer professional cooperative economic organizations and its influencing factors. *Manag. World* **2010**, *5*, 75–81.
31. Tian, Y. Analysis of the impact of the function of circulation services played by farmers' professional cooperatives. *Agric. Technol. Econ.* **2016**, *2*, 92–102.
32. Liao, X.; Deng, H.; Shen, G. Research on the Mechanism of High-Quality Development of Farmer Cooperatives. *J. Nanjing Agric. Univ. Soc. Sci. Ed.* **2021**, *21*, 148–158.
33. He, X.R. Reflections on the scale of agricultural business in China. *Agric. Econ. Issues* **2016**, *37*, 4–15. [[CrossRef](#)]

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